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CONTENTS

May, 1959

Papers

	Page
Ethical Aspects of Engineer Recruitment by William G. Benko	1
Humanity Faces a Technological Culture by Mario G. Salvadori	5
The Importance of Balance in Engineering Education by John B. Wilbur	15
Problems of County and Municipal Engineers in Civil Service by Jean L. Vincenz	21
Discussion	27
Committee on Engineers in Public Practice by M. J. Shelton	37
Problems of Civil Engineers in State Civil Service by Robert D. Gray	41

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2026 May, 1959 PP 1

Journal of
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ETHICAL ASPECTS OF ENGINEER RECRUITMENT

William G. Benko[1]

SYNOPSIS

This paper contrasts present day recruiting practices with the intense aggressive recruiting of a few years ago, illustrates the effect of unethical practices, and acknowledges the graduating engineer's part in these practices. It emphasizes the need for and the trend toward practices beneficial to the engineering profession and industry as a whole.

ABSTRACT

"In the tight market for engineering talent two broad factors predominate. First, you've got to attract the engineer. Second, you've got to hold him." So wrote Irving Stone in his article "How to Get and Hold Your Engineers" which appeared in the February 1, 1954 issue of Aviation Week. This paper will deal primarily with the first factor.

The situation has changed considerably from that which existed when the article was written, or for that matter, the situation which existed up to a very few months ago. At present, industry is not so anxious to draft each and every warm body available. The market for engineering personnel has ceased to be tight.

Reasons for the Change in the Labor Market

There are three apparent reasons for this situation. First, engineers are being used more efficiently now than before. That is to say, engineers are given job assignments that are more consistent with their level of training. Second, the colleges and universities are graduating more engineers to meet

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the present needs. Finally, the present recession is beginning to make itself felt at the professional level of engineers.

It is obvious that the lean period in our economy has been a significant factor which has brought about the change in the market. However, the first two factors have had a significant effect on engineering recruiting practices as well. The effect will be more clear when a comparison is made between present-day recruiting practices and past recruiting practices.

Past Recruiting Practices

The extreme example of past recruiting practices is typified by the policy of blanket recruiting. It is said that some companies have gone as far as to hire an entire class sight unseen. This practice was detrimental to the interests of the companies and to the interests of the personnel hired. For the most part, recruiting was not carried on to this extreme, and a considerable degree of selectivity was used in acquiring new engineers.

Development of Questionable Practices

With such an extreme policy as noted above and others of a lesser degree, certain questionable recruiting practices developed. A recent survey made among a group of young engineers revealed that a number of jobs did not measure up to the glowing descriptions given them. Many of the jobs were oversold.(1) Brochures were compiled to create interest in paid vacations, more leisure time, and executive responsibility.(2) The importance of the job was heavily stressed, and promotions were said to be a mere matter of of time. These are properly termed unethical recruiting practices, particularly when the difference between representation and fact are glaring.

In some industrial firms, more engineers were hired than were really necessary. The practice was prompted by speculation on lucrative government contracts. An artificial shortage of engineers was created. The consensus of opinion is that if all registered engineers had been engaged in actual engineering work, a surplus would have existed.(3) Of course, many experienced engineers were necessarily diverted into positions of executive responsibility where their engineering knowledge was required, but many engineers were assigned to jobs for which they were over-qualified. Some companies had a surplus of talent, while others were understaffed. Thus, through speculative hiring, diversion of engineering manpower, and occasionally improper concentration of talent, a shortage was created.

The artificial shortage of engineers in some areas of industry provided a reason (or an excuse) for questionable or even unethical recruiting practices. These areas had a legitimate need for talent and this need had to be fulfilled by one means or another.

Questionable Practices Among Graduating Students

Unethical practices had other origins, also. The graduating engineer sometimes invited distortion of fact through his own actions. Some graduates, taking advantage of their status, would seek interviews with representatives from many companies knowing full well that they were not really interested

in the positions offered. The representative was induced to "sell" a job to a disinterested customer. Industry's recruiting practices were affected accordingly.

Another inconsistency noted among graduating engineers had a direct effect on recruiting practices. Some surveys indicated that engineering graduates considered potential growth and challenging opportunity more important than starting salary and "regular pay increases," when seeking a job. Yet, a poll made among a large number of executives indicated that the most effective means of recruiting and holding new engineering employees was salary.(4) This was especially true after the employee passed the apprenticeship stage, and the thrill of the first job in the chosen profession wore off.

Evidence of Ethical Recruiting Practices

Much to the credit of industry as a whole, many sound and ethical recruiting practices did exist and still exist today. The following guide for recruiting appeared in a recent issue of Foundry magazine:

> "Don't even look for an engineer until you're absolutely sure about these three things. (1) You need him. (2) You want him. (3) You want to help him become a happy, productive employee."(5)

In line with this philosophy, many recruiting techniques had considerable merit. They included the policy of offering a wide variety of work assignments for trainees, and work on products or projects which were highly engineered and gave greater job satisfaction. In addition, overtime pay, and payment for travel or moving expenses provided monetary satisfaction.(6) In short, these practices emphasized job satisfaction and immediate monetary reward. The "exotic" and "grandiose possibilities" in a particular job were deemphasized.(7)

Present-Day Trends

The previous practice of intense and aggressive recruitment seems incredible when compared with the current practice. While there is still a critical shortage of engineers in many areas, industry as a whole is cautious. On the other hand, the prospects for the graduating student are not altogether unfavorable. Many employers still follow a consistent schedule of campus interviewing during the current slack period.(8) Industry can ill afford the practice of hiring only during the "boom" years if they are to have personnel available with the knowledge necessary for research and continued development. Ultimate survival may very well depend on immediate availability of trained engineers.

CONCLUSION

From the foregoing discussion, there is evidence that unethical recruiting practices did exist in the past and no doubt some still exist. The practices were prompted by economic conditions, diversion of qualified engineering personnel in some areas, over-concentration of talent in other areas, and the actions of graduating engineering students themselves. One may conclude

that recruiting techniques need to be developed that would be effective, rewarding, and ethical for both industry and the graduating student. One such technique would be to encourage the young graduates to continue their education as well as to strive for advancement within the company. In the words of Ronald S. Smith, president of the M.W. Kellogg Company: "Industry and education must now bear the joint responsibility for the furtherance of the engineering profession as a whole. It is up to industry, however, to provide the additional incentive that makes the concept (that a professional man's education is never ended) realistic from the moment the graduate enters the organization."(9)

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2027 May, 1959 PP 1

Journal of
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HUMANITY FACES A TECHNOLOGICAL CULTURE

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SYNOPSIS

"The author reviews the tremendous rate of cultural change in the world to-day and points out the psychological and human difficulties encountered by mankind as a consequence of such changes. He tries to evaluate the essential problems in the education of the technologist of the future and proposes some basic changes in the approach to education that might better prepare the student for the group culture of to-morrow."

In civilized life a non-violent fight goes on perpetually between the individual and society. A successful culture enhances the positive aspects and minimizes the negative aspects of this fight. Education is a process developed by society to achieve a dual purpose: to better prepare the individual for the fight and to make him more useful to society. A stable culture presents the possibility of a friendly fight according to well established rules. Education in a stable culture is a clear and relatively easy process: society knows what it wants from the individual and the individual knows what it may require from society. This knowledge changes slowly in time and gives a good chance to adjust to both the individual and society. The first educators, the parents have almost by instinct the respect of their offspring and transmit to them the knowledge, factual and ethical, they obtained from their own parents. This state of affairs is symbolized by proverbs like "What was good for my parents is good for me," in wnich the wisdom of a society expresses its continuity in time and space. Of course, no society is static. The development of a culture is a biological and spiritual process requiring change in order to avoid death. Hence, the educational process of even a stable society presents difficulties inherent to all life phenomena: the natural inertia of the human mind must be overcome in order to foster the

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evolution of the educational process, and this evolution is always accompanied by contrasts between the educators and the educated.

The interrelation between a society and its educational process is of a dual nature: on one hand society forges the educational system best suited to the continuation of its ideals, on the other, the educational process creates and maintains the ideals of a society and gives them reality within the framework of available possibilities. Once again the educators, representing the conservative side of society, try to give stability to ideals and practices, while the educated pupils strive to change these ideals according to the dynamics of their progressive age. Hence, the perpetual contrast between the two parties and the creative clash between the old and the young, between the pushers and the pullers. "I am scared of the young man who is not progressive and of the old who is," stated a French philosopher, well expressing the natural clash of interests of the two sides of society.

The situation described above becomes progressively more acute as the tempo of history accelerates and both parties to the cultural dynamic process find the time available inadequate for changes in the deep traits of their society. In extreme cases a society may become culturally unstable and the necessary changes occur in a revolutionary manner, under the impulse of the ultraprogressive and often unwise pushers. Of necessity, the pendulum swings back in due time as shown, for example, by the educational practices of the USSR immediately after the revolution and 25 years later.

Ours are times of deep upheavals in all fields of human endeavor. It is my contention that humanity was never faced with such speed changes in the cultural aspects of practically all her societies and that the tremendous educational difficulties encountered all over the civilized world today are symptoms of these changes. It is therefore my contention that any discussion on education which does not carefully consider the new tempo of history and is artificially limited to the consideration of specific educational problems is useless and wasted. I will try to prove these points in what follows.

"Nihil sub sole novi," there is nothing new under the sun, used to say the Romans, and many of us are inclined to feel this to be still true today. A quick look around us will prove how false this assumption. To begin with, it might be well consider men, since cultures and educational processes have to do essentially with people. The population of the world immediately prior to the French revolution was approximately 1 billion people. At the beginning of our century we were less than 2 billion people. We are today over 2 and 1/2 billion people and the extrapolators tell us that in 100 years we might well be over 6 billion. The fact that the earth is getting crowded is new. It is also unprecedented that the nutritionist be scared, not because of lack of agricultural produce, but because so far the increase in farming products cannot keep up with the increase in population. It was enough for the Rockefeller Foundation to spend 1/2 million dollars on improving the sanitary conditions in Ceylon to produce in that island an increase in population of the order of 20% in 12 years while the increase in food production barely reached 10%. But from our viewpoint, the numerical increase in population is a minor factor compared to what a South American scholar has correctly named the increase in the psychological density of the population. If only 100 years ago the population of the earth was one-half of what it is today, only a fraction of this population really "counted." Only a minute minority could read and write, had a right to vote, participated in the social and political life of the civilized world. Most men could barely keep their bones

together and their standards of life were only slightly above those of the animals. The whole of Africa and most of Asia was in such condition and even on the American continent most people were too busy trying to subsist to be "felt" at home or in the world at large. The psychological density of the world has increased much more rapidly than its numerical density and probably 20 to 30% of the population is felt today all over the earth. Mr. Dulles cannot ignore the opinion of the fellah in Egypt, while Gladstone could safely proceed with a good knowledge of the thoughts of a handful of people in England and the European continent. This is also new.

The above mentioned increased population finds itself moreover on a greatly shrunken earth. We can travel from New York to Paris in 10 hours, but our thought can travel from here to there in a matter of a few thousands of a second. We can look at a gathering of people in Trafalgar Square, London, while the gathering is on, and the citizens of New York and San Francisco, 4000 miles apart, enjoy the same program on TV, as do every day the people of London, Paris and Rome. Our intercourse with the other people of the world is therefore 10,000 times more intimate and our ideas and modes of behavior loose rapidly the characteristics that have so far typified and separated the sovereign people of this planet. This is also new.

The shrinking of the earth is one of the phenomena due to our technological developments and lest we should underestimate the influence of technology on man let us remember that our fathers had no radio, no television, no planes, no sulpha and no penicillin, no atom bombs and no nuclear energy, no missiles and no rockets. The influence of the new means of mass communication on the leveling of standards and on the psychological crowding of the world have been mentioned above. Because of sulpha and penicillin and new techniques of surgery our average life span is now 79 years, while it was only 65 a few years ago. Hence, there are more grandparents at a time when the progressives are definitely in charge. Our psychological cultural conflicts are on the increase. Nuclear energy is changing the pattern of world power by eliminating the egemony of those who have the sources of oil, and hydrogen bombs have made war impossible, requiring the serious consideration of new means of settling political problems. Rockets are opening up space to us who until yesterday were madly fighting over national boundaries. All of this is physically, mentally and morally new.

The influence of technology may be deep and increasing, but other factors in what may be called the realm of the spirit are just as important. Let us consider for a moment the arts, one of the two fundamental expressions of the human mind. Seldom has history witnessed such a tremendous push on all the fronts in this field and never has been the participation of the mass of the people as lively as it is today in all sorts of artistic endeavors. Music, after four centuries of deeply interesting, but slowly changing stages recently discovered a method of expression involving a new scale and is desperately trying to use electronic devices to create an entirely new range of sounds. Poetry is being liberated from the harsh limitation of classical rythms and rymes in order to achieve a level of understanding nearer the almost unspeakable terms of our subconscious mind, but never loosing sight of the eternally changing esthetic values of the spoken word. Painting has at long last reached the level of art already achieved by music centuries ago by discarding the pedestrian imitation of nature and inventing his own world. And the three-dimensional world of sculpture follows in the same path. The color-sound movies, which will soon reach three-dimensionality, are giving us entirely

new realms of composite arts, involving poetry, painting and music and adding the element of motion. Is it a wonder that, while interest in the arts is at an all time high, some people are lost in this sudden and powerful surge of new artistic ideas and methods of expression?

It is easy to go from the field of the individual, slightly more characteristic of the arts, to the collective field of scientific thought. Here the new developments are of an explosive nature. Who can call himself an engineer? There are at least 6 basic kinds of engineers officially recognized by that many degrees, but each school grants a special kind of degree in a special kind of engineering and two men with the same diploma often speak languages so totally different as to be unable to understand each other. There are 20 kinds of mathematicians, to say the least, and even a new branch of physics such as nuclear physics is, has its own specialists who barely talk to each other. And what has been mentioned of a few scientific and technological fields could be repeated for all of them. With this additional thought that the progress of the last 20 years, stupendous as it was, is nothing compared to the progress we shall witness in the next 20 since this kind of progress is a chain reaction in which each new thought creates two new ideas. Again, this is a new state of affairs and it is no wonder that a few of us feel lost in the seas we are daily uncovering.

One of the most dramatic consequences of this accelerated rate of change is the transformation of the usual undertow between the old and the new generations into what seems to be open warfare. The traditional respect for the opinions of the parent and the teacher has become a continuous challenge. Confronted with situations for which they were totally unprepared, the young put the blame on their elders and feel that they alone will have to find appropriate solutions. The elders, on the other hand, entirely confused by the sudden upheaval in the fundamental values of life, blame the young ones for this state of affairs. Neither is consciously aware that nobody is to blame. With the sacred cows of nationalism, and of sovereignty going, not to say gone, with human relations among relatives becoming more and more tenuous because of the newly acquired mobility of the family, the words country, father, mother, brother, citizen have at present meanings substantially different from their meaning of only 100 years ago. The elders interpret this change of meaning as a relaxation of fundamental ethical values, the young consider these new relationships more honest and real. The chasm between the generations becomes wider and the worldwide phenomenon of juvenile delinquency, of open rebellion to authority (or of unspoken rebellion causing deep psychological trouble) stares us in the face. Some deeply rooted cultures feel these difficulties in a lesser degree than some more progressive and less established ones; but the same quality of difficulties is apparent everywhere.

The separation of the generations brings about a new type of loneliness and sadness. Gone are those relationships that were so helpful in smoothing out the daily difficulties of life. Gone, for most of us, those islands of contemplation and rest so necessary to build up anew our strength. The demands on us increase both because of our increased activity and because of the increased contacts made possible by our means of communication and by the psychological density of the population. Anybody who is anybody corresponds today with his counterparts on 5 continents and this spreading of relationships can only be gained at the cost of their depth. Here is the origin of the philosophy of the essential loneliness of man, felt in the past by a few

oversensitive individuals, but a common disease of the mind today. Hence, also, the atmosphere of fear, instability, at times, madness, in which most of us feel we are living, and the arising of new non-transcendental religions, in which man hopes to find the solace traditionally given by the consideration of the divine.

This birdseye view of our present state was necessary to understand the real basis of our educational crisis. An educational philosophy and a corresponding educational system are easy established provided one knows whom to educate for what, and provided the person to be educated accepts the tenets and the practical aspects of the proposed plan. Put in these terms our present predicament seems hopeless. We cannot know what to educate for since our standards of behavior and knowledge change so rapidly that what seems correct today may be entirely wrong tomorrow. We do not know whom to educate since intellectually we ought to educate the best, but emotionally we feel we must educate (or try to educate) everybody. (This is not only true in those countries in which democracy so dictates but all over the world because the increased psychological density of the population automatically creates an increased pressure towards more education for everybody.) The masses to be educated refuse, more or less openly, to accept the recognized tenets of education, as established by the past 2 or 3 generations, and above all fight the practical aspects of education in view of a certain hurry, in whose name shortcuts to knowledge are demanded vociferously by youngsters who will statistically live 20 more years than their parents.

When a situation is so totally unsettled, cowards and admirers of the past shut their eyes and cry. But an explosive situation presents such terrific potentialities to men of wisdom and good will that I venture to define our age as one of the more interesting, challenging and constructive mankind has ever seen. Let us face it courageously.

If I know that I shall start in the near future on a long and demanding journey into an unknown land, I shall try, above all, to train myself so as to be healthy, independent, and ready to face unfamiliar situations. I shall, therefore, make sure that my body is in good shape, that my baggage is light but contains clothing to protect me in hot and cold weather, that my mind is alert so as to react promptly in an emergency. I will forego all the unessentials and limit the tools in my pack to those useful in a variety of situations, even if not ideally suited to any one of them. I suggest that we ought to prepare our young people in the same spirit to the hazardous trip he will undertake into the future.

We can be a little more specific. The tools he will need are moral and intellectual: to solve the problem of his relations with the rest of humanity and to make himself useful to his brothers. Morality could well be expressed today, as it was in the past, by a single statement: infinite respect for life in all of its aspects. Is morality to be taught exclusively by the religionist? Should it find its only basis in religion? I don't think so. Morality can and must be taught by all of those who surround the child, the young man and the adult. This is the kind of teaching not to be found in books; it is based exclusively on apprenticeship and example, it cannot be imposed logically or accepted intellectually. It must continue through life and is self-exciting: life among moral people makes us more ethical, even though very high morality exist in the most immoral surroundings. Perhaps, one obvious thought should be added: at times, in the past, a certain kind of limited morality was taught involving only those near us or dear to us. The shrinking

of the physical and the psychological world makes this limited morality totally unacceptable today. Nothing less than a world-wide morality will work. The psychological density of the earth population makes the brotherhood of man real to all of us even though it was felt only by the very few in the past.

The educationist is more directly responsible for the development of the intellectual tools of his pupil and is confronted with a more difficult problem because of the almost unlimited amount of knowledge rapidly being accumulated by modern man. It would seem that in the present circumstances one of the former goals of education must be abandoned: we cannot hope to give our young men information, even incomplete information in any of the recognized fields of knowledge. The speed with which the essential new facts accumulate and change in importance from decade to decade indicates that the acquisition of factual information is by now the task of the mature, self-improving professional and not the aim of the student. The tendency to atomize knowledge through the institution of innumerable specific and specialized courses is to be abandoned on two accounts: it is stultyfying, inasmuch as the information imparted in such courses may well be either false or totally immaterial a few years from now; it is dangerous, inasmuch as it tends to create specialists unable to grasp fundamental ideas and to communicate with others. The Tower of Babel can easily be built anew with the same old consequences.

It becomes necessary, therefore, to consider education, even at the purely intellectual level, as a formative rather than an informative process. Education is to be considered as a training of the mind capable of transforming it into a sensitive and logical tool well adapted to mastering a variety of unforeseeable situations. The first purpose of this kind of education is clear analytical and synthetic though. Since synthesis cannot preceed analysis, let us consider ways and means of training the young mind towards analysis. Thought processes are intimately connected with verbal expression: we think what we can say, we do not say what we can think. The complete mastery of verbal expression, and, hence, of our mother tongue is the first step towards logical analytical thought. In this connection it must be remembered that some languages have developed means of expression that are more logical than others. For example, the inflected languages (Latin, German, Russian) with their emphasis on the ending of words and the relative unimportance of their order, foster almost naturally a more logical frame of mind in the child. In English, the meaning of the sentence "The man kills the dog" depends entirely on the order of the words in the sentence, as shown by the inversion "The dog kills the man"; in German the words of the same sentence could be scrambled in a variety of ways without changing their precise meaning. This is the basic reason for a study of Latin in high-school: the proponents and defenders of Latin are on strong ground when they state that such study is conducive to a thorough comprehension of analytical thought.

Being entirely aware of the advantages of the study of Latin, I wish to put forward the thought that by now the same important results could be achieved by means of live language with the added advantage of not wasting time on a dead tongue. The philologist and the modern grammarian have given us recently an approach to our own language which is based on a deep and fascinating analysis of the process of expression. This approach has been known for centuries, even in countries whose languages are similar to ours, under the name of "logical analysis." I can easily see our young man tackle

the study of English on this basis with two tremendous advantages: a better comprehension of their own tongue and a facilitated approach to the study of foreign languages.

The other fundamental subject to be tackled by any student eager to grasp the essentials of the modern world is mathematics. Here again a basic study of mathematics presents two advantages: the formation of a logical mind through the understanding of the most important branch of logic, and the acquisition of a formidable tool for an approach to science. The advantages accrue to the mathematics student from the two different viewpoints from which mathematics can be tackled: the purely logical game of deriving theorems from axioms and the efficient technique of interpreting physical situations in mathematical terms. I am afraid that the increasing need for the applications of mathematics has pushed pure mathematics in the background to the detriment of the formative aspects of mathematical thought. Once more the choice is between formation, and information and the advantages obtainable from mathematics as a formative subject should not be underrated. It is a crime that only Eucledian geometry be taught according to the classical, logical method developed by the Greeks, while algebra and, only too often, even the calculus become a set of practical rules for the solution of certain problems. I deeply feel that in the future we must go back to the teaching of rigorous mathematics even in the elementary schools if we wish to derive from this discipline all it can give our young men and that no other discipline can give so well.

Once the fundamentals of analytical thought are deeply entrenched in the mind of the student, then and only then is he ready to approach synthetic thought. And here is where the humanities play their role. The history of mankind should be known to us as the history of the human spirit: art is in this connection as important as mathematics to all of us, including the professional engineer or physicist. But all forms of artistic thought are basically intuitive and synthetic and no student should be exposed to this exciting and dangerous form of thought without a good training in logic. After all, the development of civilization consists in the painful acquisition of mental controls through the use of foresight and logic at the expenses of purely emotional behavior. The artistic achievements of certain ancient cultures or certain barbaric tribes may be very high, but mankind had to proceed slowly along the path of reason in order to reach a level of maturity. I am, therefore, proposing that in our curricula the humanities be given the importance they deserve but should not be introduced until the student is ready to acquire this kind of knowledge.

The description given so far of a modern educational process is open to severe criticism from a practical viewpoint. I seem to hear the leader of industry and government complain: this young man who is a master of pure mathematics, who knows the logic of his own language and possibly of other languages, and who is conversant with the humanities, might be an interesting product, but he is totally useless to me. He doesn't know anything yet:" There are two answers to this objection. In the first place, this leader ought to realize by now that the schooling years, even if prolonged substantially will never produce the kind of man he can use efficiently immediately after college. Years of apprenticeship must follow in which the leader himself will teach the college graduate the particularized knowledge needed in a particular situation. In the second place, the emphasis I have put above on analytical thought brings us to a corollary of great importance. Analytical thought is

necessarily detailed. Our young men and women cannot afford to spend time on so-called survey courses, leading to a journalistic knowledge of wide fields of science or art. Not only, they don't get anything of permanent value out of these courses; what is worse they acquire detrimental study habits that might well prevent the acquisition of solid knowledge later on. I deem of extreme importance that the student be exposed to a most thorough and uncompromising study of a particular and limited field of knowledge as a training in correct study habits. Depending upon the interests, natural disposition and foreseeable future activity of the student, the limited subject matter he must be compelled to study with professional, creative thoroughness will be of immediate value to him in his employment. Thus, a widely trained mind can be made aware of the intricacies of one of our modern fields of endeavor and becomes more useful to society at an early age.

No discussion of the general trends of education for the future can ignore the difficult problem of communication, hinted at above. The common intercourse with all the peoples of the world has made communication a real problem in the international field, but the communication problem between specialists is more acute and urgent since it might strangle the harmonious development of our civilization. If it is impossible to acquire complete knowledge even in a specialized field of endeavor, how can we hope to know enough about more than one field? I believe that the problem might be solved by giving increasing importance to a new kind of person, whom I like to call the translator. He is a man conversant with knowledge in two or more adjoining fields, who doesn't know enough to be creative in any of them, but can translate knowledge in one into knowledge in another field. The mathematician is obviously a powerful translator since his language can express thoughts in a variety of applied fields, but there are many other possibilities. It might be said that almost any two fields of knowledge can be interpreted today with immediate and useful results. More of the less genial of us should devote their time and energy to this task. I also believe that the emphasis on original research on the part of the less endowed of us is detrimental to the creation of knowledge and produces a more difficult communication problem on two accounts. First of all, innumerable papers of small value clutter the literature to such an extent that even reading the review magazines is an unsurmountable problem. Secondly, the bright but not necessarily creative research man is not satisfied with writing monographs on specific subjects that would make communication so much easier. Our society will have to find ways of eliciting such review papers and of discouraging the unnecessary minor papers by putting a price on the first and penalizing the second.

The leveling of living standards is proceeding at such an accelerated pace the world over that a false interpretation of the democratic principle might bring about a leveling of intellectual and educational values. The last goal to be kept in mind in overhauling our educational system is the salvaging of the exceptional individual from the encroachments of mass education. Paraphrasing the communist manifesto, one could say in a real democracy: to each according to his capacities, from each according to his education. It is psychologically and morally wrong to foster on the uncapable mind the kind of knowledge it cannot absorb: this leads to unbalanced and unsatisfied individuals who are obnoxious to themselves and dangerous to society. It is just as wrong not to expose all of our young to the liberating experience of an education. A sound democracy must find ways and means of discriminating between those who can and therefore must obtain a higher education and

those who cannot and should not give it even a try. The democracy of thought consists in discovering and accepting the aristocracy of the intellect, since the greater number of men psychologically capable of participating in the life of our culture does not require a greater number of leaders, but leaders of higher quality.

The drama and beauty of life is that men, nations and cultures are perpetually in danger of dying, but can be saved. The need of salvation for each of us and for our culture is as great or greater than ever. We shall deserve life rather than death only if we are ready to face our technological culture unafraid and to throw away all of our prejudices in favor of more encompassing set of ideas.

This is the challenge to education in the years ahead of us: a perpetual challenge made slightly more difficult by our rapidly changing world.

Journal of
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THE IMPORTANCE OF BALANCE IN ENGINEERING EDUCATION

John B. Wilbur,[1] M. ASCE

ABSTRACT

The engineer must have a firm grounding in science, but he must operate in areas that are in part above and beyond the well-documented areas of systematized knowledge. If the art of harmonizing and relating conflicting forces and tendencies be crowded out by science to the point where we are merely training scientific technicians, the essence of professionalism in engineering will be lost.

Engineering has been defined as the science and the art of using the forces and materials of nature for the benefit and convenience of man. Now it was originally suggested that for my part in this discussion I might wish to emphasize the importance of the art in engineering education. It is true that I am among those who still hold to the belief—even though it may be somewhat out of fashion in these space-minded days of Sputniks, Supersonics and Servomechanisms—the belief that in engineering, the art is still clearly of the essence. Yet I would not emphasize the importance of the art as opposed to that of the science, lest this stamp me as being anti-science in my view—an outlook quite as indefensible, I think, as that of being anti-art.

Rather, I take the position that in engineering education, there must be an optimum balance between the science and the art—that we should strive to achieve, or at least to approach, this balance—that we should not pass it blindly by, our sight diverted, as it were, gazing the while in starry-eyed wonder at the mirage of a bright new world of tomorrow, that surpasses even the fondest dream of our science-fiction writers. If holding this view be the mark of an anti-scientist, you should make the most of it; though you will

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have some trouble, I think, in making the label stick. This would be akin, perhaps, to calling a man an anglophobe, because he savors his coffee as well as his pot of tea.

Now should there be room for confusion about the meaning of science there is a great deal more of it when we talk about the art. What is this art of engineering? Or, more specifically, what do I mean when I view it as a component of engineering education that deserves a status that is more or less comparable to that of the science? I do not use the word in its aesthetic sense, although that is not without some bearing on our problem. Neither do I use it to cover the myriad details of engineering practice that have come into use with the passing of the years. The days of engineering education centering on that kind of art are clearly done for—save as a red herring pulled out of the briny deep, from time to time, by those who would have us believe that waters even suspected of harboring the art must surely be polluted. If, today, there remain educators who long for a return to the good old days of engineering practice, I am not acquainted with them.

Since I must attempt to define the art, I will say that it is that means by which we are sometimes able to reach understandings and results that could not be achieved solely on the basis of orderly, logical applications of scientific analysis. Let me give just two examples of this, and each from the field of engineering.

The first has to do with selection. Suppose we are seeking the optimum location of a highway, which may depend on a combination of social, political, legal, functional, economic, technical and aesthetic factors. Some of these aspects are susceptible to analysis, while others are not; but, in any event, we seek the best location, thinking of the whole—that is, taking all of these factors into consideration. Now if there is any common denominator for all these facets, I have not come across it; so that we lack a wholly rational basis for alternate comparisons. In the end, therefore, selections of this kind must depend on judgment; and the exercise of good judgment is not only an art, but a very fine art, indeed. To be certain, the orderly, logical, frequently powerful tools of scientific analysis should be used to the hilt to serve as a guide to our judgment, but herein we have an important truth: Analysis is an invaluable guide to the art of judgment; but it is rarely, if ever, a substitute for it.

Or again: Suppose we are seeking a solution to a problem that has never before been solved. Who among us has not had the experience of looking for such a solution for a long time—and suddenly it has evolved, and perhaps at a time when we are thinking the least about it? As soon as we have the new idea, we immediately put logic to work to see if the thought stands up; and if it survives this cold light of inquiry, we commence to improve and refine the new concept by further rational analysis. I think, however, we must at least suspect that this analysis is rarely a creative instrument in itself, but chiefly a forerunner and refiner of creativity. The actual creative process would seem more likely to be some kind of a little-understood synthesis, in which intuition and imagination play important parts—a process not so much a science, as an art.

It may be that the logical, orderly methods of analysis are primarily methods of search which, by themselves, can seek, but can never find—perhaps it is the less formal, less understood methods of synthesis that are the mechanisms by which we glimpse new concepts and recognize the possible fitness of overall solutions. This may be—indeed, probably is—an

oversimplification; yet, perhaps what I am trying to say is that while it is fine for our students to excel in the science of orderly search and research, it is even better if they can match this science with the art of sometimes and somehow transcending the routine search so as to go more directly to the goals that are being sought.

Perhaps I am also asking if it isn't just barely possible that the much-vaunted logical mind, with all of its prowess and record of proud accomplishment, may not be quite as versatile, quite as all-embracing, quite as omnipotent, as we would sometimes like to believe. Now I think it fair game to bring this question up—not only because so many members of engineering faculties are presently convinced of the near-sublimity of logic, but, indeed, if I can sense the trend with any degree of competence, because there is every indication of more and more deification of the logical mental processes, as engineering education becomes more and more identified with the engineering sciences. Twenty-five years ago, we were on the verge of a great revolution in engineering education—a revolution based on the belief that education of the highest type rested on contact with creative scholars—a contact that permitted some of the stardust, perchance by some obscure process of osmosis, to be transmitted from the teacher to the taught. Now we are caught in the toils of a new upheaval and one of no less consequence—and this time springing from the premise that students in engineering should carefully insulated from engineering itself—that, indeed, the royal road to first-class citizenship in tomorrow's world of engineering, is paved almost exclusively with science and with engineering science.

The question that I raise this afternoon, as we attempt to look ahead in engineering education, is, briefly, whether or not this new emphasis on science and on engineering science, with its corresponding emphasis—its almost exclusive emphasis—on the wholly logical and therefore greatly oversimplified approach to things is, or can be made to be, consistent with the type of balanced mental development that marks the professional engineer as an educated man.

More specifically, I question the overall wisdom of today's tendency, based on the premise that today's engineer is ill-equipped to keep pace with a rapidly accelerating technology, toward what has been tagged "open-ended" education in engineering—the phrase "open-ended" being used to emphasize the claim that because of a thorough grounding in science and engineering science for all, or at least for our best engineering students, they will be rescued from so-called "captive vocations" and have a base sufficiently broad to permit them to enter into any area of engineering.

This sounds like a noble goal, yet the point that seems to be stubbornly overlooked—and in my opinion it is a highly important, indeed; it is the crucial point—is that so-called "open-ended" education may in the end prove to be "close-minded"—that is, highly restrictive with respect to the mental qualifications of a man regardless of the field in which he finds himself. By concentrating on the exact and rigorous thinking of science and engineering science, the student has, hopefully, become something of an expert in dealing with situations where all is systemized; and where all the components of a situation can be put together into a solution that can be called "correct"; and where every other solution is said to be "incorrect." But he may be at something of a loss to deal effectively with the more typical situations of engineering and, indeed, of life—situations that involve intangibles—circumstances where a so-called "correct" solution has little if any meaning—and where, at

best, one can only find better ways of doing things. A far-reaching substitution of scientific training for education in engineering itself, will be made, therefore, at a heavy price—for because of almost exclusive concentration on the logical mental processes the prospect of balanced mental development for tomorrow's engineers may well become sacrificed on the altar of the "open-ended" concept. I suggest that we pause and take stock, and refrain from a headlong plunge into an educational pattern which under the banner of breadth of base, operates, in fact, within a narrow and restrictive spectrum of knowledge, attitudes and intellectual techniques.

I think we need, today, to once again ask ourselves the question of just what engineering is, and particularly of how it differs from science. Somehow, people have become a little confused about this. Today, for example, the press hails Wernher von Braum as a top "missile scientist" rather than as the excellent engineer that he is.

There can be little doubt but that the border line between engineering and science has become a little cloudy in recent years. "Crash" research programs in which military necessity frequently dictated that economics be tossed largely to the winds, contributed to this situation. In fact, there seems to have developed, in certain quarters, a feeling that scientists—and especially physicists—have now proven themselves to be better engineers than are engineers, themselves; wherefrom there seems to have emerged the gospel that it is better to be a second-rate scientist than to be a first-rate engineer.

Now we certainly need scientists and engineering scientists, and we need them badly. We need more research on missiles, and more on nuclear energy, and we need more study into a whole gamut of things that will underlie the conquest of space. The point, however, that I wish to stress this afternoon is that while we need scientists and engineering scientists, we have just as great a need for engineers; and we also need engineering humanists—and, indeed, just plain humanists. The conquest of outer space may be the most sensational prospect of the moment, but the fact remains that most of tomorrow's engineering will still be done right here on earth. And being largely earthbound, it is a safe bet that a pretty fair amount of engineering tomorrow, even as today, will continue to revolve around people—and when I say people, I mean earthlings—and not little green people with great big ears.

Let us not forget that there are two related, yet somehow divergent aspects of technology: the first, which is dramatically apparent to everyone is today's rapid pace of scientific and technological advance; the second, which if more subtle is none the less vital, is the extent to which civilization is able or, perhaps more correctly, unable, to keep pace with the impact of scientific and technological development. The gap between these two aspects is appreciable; the lag in the ability of society to assimilate technological advance into its culture appears to constitute one of the major problems of our time and of the foreseeable future. Technology, in crossing the boundary of insured control, has swept us into an era of new dimensions. This twentieth century is a time when it will be determined whether the products of technology are to be meaningfully used or frightfully abused. In a world polarized around science, we must be on our guard against the mere dispensation of knowledge, without a simultaneous effort to engender sufficient perspective to direct this knowledge for the common good.

It seems appropriate, therefore, to suggest that while technical "know-how" is indispensable to engineering, human "know-what" may well be its

more challenging and elusive dimension. One has only to think in terms of some of the great areas of civil engineering—such as transportation, water resources, housing, and public health—to appreciate the probable validity of this viewpoint. The stand could well be taken—indeed, I take the stand—that engineering, in its broadest sense, revolves around an understanding of man's condition, and an aim to better it, and that the significance of technological advance arises from the fact that it provides a means which—if properly used—can help to make this betterment possible.

It would seem, then, that values in engineering education should be weighed in terms of meaningful integration of technological advance into our social-economic complex, as well as by technological advance, itself. The humanities and the social sciences are more than a peripheral boundary to engineering; they are—or at least they ought to be—intimately interwoven into the engineering fabric itself. The need for bringing science and the humanities together is no less pressing in education than it is in our broader culture; and engineering—which cuts across substantially every sphere of human activity—can, if properly interpreted, serve as an ideal integrating medium for the two.

The engineer must, of a certainty, have a firm grounding in science, but in professional practice, such knowledge is but a springboard for most of the situations he will encounter. He must operate in areas that are in part above and beyond the well-documented but relatively limited areas of systematized knowledge. Perhaps the principal function of the truly professional engineer is to harmonize and relate the conflicting forces and tendencies that—unlike the situations encountered in pure science—are bound to be present when one attempts to apply science to the welfare of society. Such a process of harmonizing and relating is not a science, but is an art in the highest sense, and if this art is crowded out by science to the point where we are merely training scientific technicians, then the very essence of professionalism in civil engineering will likewise be lost into the bargain.

Like most things, it is a matter of balance. We must have science in engineering—indeed, a thorough treatment of science; but we must not be satisfied with science alone. We must not be satisfied with anything less than science "plus." This indispensable plus factor is the engineering judgment, the intuition, the imagination—in short, it is the art that is needed to translate the cold abstractions of science into the living realities of human betterment.

May engineering, therefore, ever cherish science, as a prime source of knowledge—without which it could not serve; but may it cherish, with equal fervor, the art of using science wisely—and thus seek wisdom as the guide to serving man. Thank you.

Journal of
PROFESSIONAL PRACTICE
Proceedings of the American Society of Civil Engineers

PROBLEMS OF COUNTY AND MUNICIPAL ENGINEERS IN CIVIL SERVICE[a]

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ABSTRACT

There can be real value to engineers employed in civil service provided the system is modern. Continuing salary studies, reasonably frequent classification adjustments, and promotional advantages, together with fringe benefits covering adequate retirement, vacation, and sick leave system all help balance the fact that salaries of engineers in government lag behind comparable positions in private industry.

Probably the first thought that flashes into one's mind upon reading the above title concerns salaries. It will be important, therefore, that the problem of salaries be discussed in this paper. However, at the outset attention is called to the fact that there are other problems of engineers in civil service. Many members of the Society who are engineers in public service are in a supervisory capacity. It seems important, then, in presenting this paper to consider both sides of the problems as they relate to the members of this Society. So, briefly, the matters of salaries, selection, security, and retirement are considered.

Salaries

Largely because of the high degree of professionalism that has been brought into the field of civil service, that activity is functioning far more effectively than was the case 20, 30, or 40 years ago. Many of those who favored the spoils system are either departed from office or have come to

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a. Presented at the February 1959 ASCE Convention in Los Angeles, Calif.

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recognize that there are real values in civil service. Particularly this is true of those who are the appointing authorities and must be responsible for the acts of their appointees. Cities throughout the nation to a large degree have made civil service a part of their government. County governments have been slower in this regard but are rapidly recognizing the values of civil service. In California, civil service is an active part of practically all city and county governments.

But civil service to be effective must be a live, developing thing. It is extremely easy over a period of years, particularly in a growing agency, for the duties and responsibilities of jobs that were once classified similarly to become quite dissimilar. For example, a man with a rating of Engineer Grade IV, who has initiative and willingness to accept assignment of responsibilities, may well become assigned to duties completely out of balance with others classified as Engineer Grade IV. In the same way, those Engineers Grade IV, whose duties are not nearly so important, may currently be performing duties requiring skills far lower than the average Engineer Grade IV. This stage is very frequently reached in city and county governments without it being realized.

This then becomes one of the first problems of the engineer in civil service. It is essential that proper reclassification studies be undertaken so that persons with like duties and responsibilities can be properly classified. Using the previous example, the results of a reclassification study well could show that one engineer should now be rated as Senior Civil Engineer instead of Engineer Grade IV, while another Engineer Grade IV should properly be classified as Assistant Civil Engineer.

The thought to be emphasized here is that unless classifications are adequate and current, proper comparisons salarywise are impossible. This is an area where it cannot properly be said that "comparisons are odious," but it is important that the salaries which are to be compared are for jobs that are comparable.

A progressive, efficient civil service staff may be able to keep all classifications current. Ordinarily, however, it will probably be found that the civil service staffs are so limited in number or quality that it is impossible for them to do as good a job in this area as they recognize is desirable. For this reason, many agencies have found it highly desirable to contract with consulting firms, highly experienced in these particular fields, to make classification and salary surveys and reports. Such a study, for example, was made for the City of San Diego in 1951, resulting in substantial upward adjustments for the engineers of that city.

This matter of having classifications current is of more importance than may be realized. Actually, it is possible that the salary structure of one group of engineers may be considerably damaged because of comparisons with the salaries of engineers in other governmental agencies where study would prove that the classifications were not at all comparable. In other words, it would be unwise to attempt to compare on a firm basis the salaries of all men designated as Principal Engineer throughout the United States. The point being emphasized is the importance of comparing only those things that are comparable.

Based on reasonably comparable job descriptions, the City of San Diego civil service department annually compares the salaries of its engineers with those of the State of California and the Cities of Los Angeles, San Francisco, Oakland, and Long Beach. The County of San Diego, which has

adjusted its classification of engineers to that of the City of San Diego, makes similar annual comparisons with the State of California, the Counties of Los Angeles and Alameda, and the City of San Diego, as well as certain other counties that provide a reasonable basis for comparison.

Fortunately for the engineers employed in these governmental agencies, such studies are made annually and without the necessity of strong demands by the employees. However, it seems certain that important contributions toward the achievement of more accurate comparisons and positive action on salary adjustments result from the activities of the various city and county employee associations, particularly when coordinated with consistent requests from responsible department heads. This last point emphasizes the earlier comment that the roll of engineers as supervisors must not be overlooked. It is very probable that unless the engineers in the top echelons continue actively to support requests and even demands for proper salary adjustments for all grades of engineers in public service, the problem of providing proper salaries for engineers will intensify. It is much easier for those at supervisory levels to urge increases in salaries for their associates than for themselves. All of you, however, have known instances of engineers at supervisory level who, while interested in obtaining a salary increase for themselves, would not turn a finger to assist their subordinates to obtain higher salaries.

It will be noted that the above is rather optimistic so far concerning the salary schedules for engineers in public service. In entirely too many agencies, however, there does not exist the awareness of the need and the interest in providing adequate salaries by those in positions to make proper adjustments. In many instances, it may be because sufficient authority is not vested in the Civil Service Commission. Also, it may be because a sense of responsibility is lacking. This same comment can apply to the Commission's staff that is supposed to advise and recommend appropriate actions of which proper salary adjustments is an important one.

Too frequently, proper salary adjustments are opposed by the City Council or Board of Supervisors. Such opposition is generally the result of lack of vision and, fortunately, is not nearly as frequent as in past years.

Occasionally, opposition will be found from taxpayer groups, particularly those that are unorganized and not equipped with a staff to make adequate studies, and even more particularly from certain self-appointed spokesmen who are having difficulty keeping up with the inroads of inflation. There will always be a few narrow-minded people in places of authority. Their inertia and lack of vision can be overcome but will require careful thought, planning and action. The local chapters of ASCE may be helpful provided their presentation is professional and their data valid.

Selection

When recruitment is necessary, the engineer at supervisory level will quickly realize the importance of having an adequate salary established for the job to be filled. If he fails to make his petition to civil service to insure an adequate salary, he can be certain of later trouble and probably deserve it. It is not necessary to mention how important it is that civil service be able to provide him with a list of engineers who can capably fill the vacancy that exists. He will want to be certain that he has provided civil service with

an adequate job description and should take an interest in assuring that a proper type of examination is to be given. Ordinarily, civil service personnel are anxious to have his advice in that regard. There should be assurance that the notice of examination has been given reasonable broadcasting in order to attract the best personnel possible.

But there are certain problems in civil service that will tend to thwart the engineering supervisor from securing the best possible engineer to fill his position. Some of these which can contribute are listed here:

1. Point for veterans' preference.
2. Limiting the examination to promotional or to a relatively small geographic area.
3. Additional points allowed for present employment with the governmental agency, and
4. Requirement of registration as an engineer.

Eyebrows will be raised and there can be arguments in favor of each of these obstacles listed. In particular cases they will be valid. But it is felt certain that it will be admitted they <u>are</u> obstacles in the way of recruiting the best possible personnel.

The question of the rule of three may be considered at this point. Many supervisors will feel that they are unable to pick the best man who may have passed the examination because they are certified with only three names. This certainly can be true, particularly when the obstacles listed above are taken into account. However, it may be pointed out that the rule of three is a whole lot better than being compelled to take the top one. There is considerable merit in the choice being expanded beyond the top three. But there are also difficulties which lack of time prevents discussing.

Under the head of selection, however, it should be noted that in almost all instances the new employee begins a probationary period during which time he can be released without too much difficulty. If the supervisor is not alert and fails to observe the new employee closely, he may find himself saddled with someone who is relatively inefficient and who is unwilling and unable to carry his full share of the load. If the supervisor is as alert as he should be it is seldom that he cannot detect these inefficiencies within the probationary period.

Security

This is a benefit more than a problem to most engineers. An engineer employed by a city or county under civil service will seldom have to move from his community. Many engineers have found that this permits them to make investments, particularly in real property, frequently resulting in financial gains greater than the savings from the salary of their entire period of employment.

For the supervising engineer, however, the inability to get rid of an inefficient employee may be a real problem. It is seldom one that cannot be overcome.

Retirement

With consideration of retirement, which again is a benefit, other fringe benefits should be recognized. An article in the December 1958 issue of "Changing Times" entitled "Don't Judge Your Pay by Your Pay Check" includes the statement "American industry spends roughly 22% of its payroll on indirect pay devices." Public service undoubtedly pays considerably less than many industries as it can have no profit-sharing or stock-option plans. It may be interesting in this connection to point out that a survey by the U.S. Chamber of Commerce entitled "Fringe Benefits 1957" shows that the banks, finance, and trust companies spent 31.7% of their payroll for fringe benefits; public utilities spent 23.5%; and the average of all the industries in the report spent 21.8%. Of course, governmental agencies are not included in the survey.

Benefits from retirement plans vary considerably among governmental agencies. San Diego County is one of several governmental agencies that contribute approximately 11% of the total payroll to the retirement funds. On the other hand, some agencies may have no retirement fund covering engineers beyond Social Security. Some life insurance and help toward the costs of health and hospital insurance are frequently provided. Policies pertaining to sick leave, vacations, and holidays are generally generous.

But this paper is to discuss problems of the engineers and not necessarily emphasize the benefits. The great problem in this area lies in the fact that a transfer from one local government to another frequently does not permit the transfer of retirement funds or any of the other fringe benefits. This is a distinct disadvantage to the engineer who is sincerely interested in public service as a career. As has been pointed out, even in the service of cities and counties, retirement and other fringe benefits are fairly substantial. It is difficult for an engineer to walk away and leave what he has accumulated in these benefits in order that he may utilize his talents to greater advantage with another public agency. It seems that one of the pressing needs for study by the Committee on Engineers in Public Practice lies in this area. The State of California has recently adopted legislation which permits an employee who moves between certain public jurisdictions to leave his funds with the first agency but receive benefits from both, based on his highest compensation. This arrangement is probably exceptional. Study of this arrangement and actions leading to adoption of similar arrangements in other states and between other jurisdictions is a very desirable goal from the standpoint of engineers in public practice.

SUMMARY

The surface of the area of civil service problems of engineers in county and municipal government is merely scratched in this discussion. An attempt has been made, however, to point up some of the problems that are probably foremost. Examples have been given that it is hoped will prove helpful and may lead to other examples that could prove to be nearer home to the personnel problems of the engineers involved.

It has been considered desirable to point out that engineers at both the supervisory level and at lower echelons have problems which in some instances are not the same. It is of particular importance that engineers of

higher echelons recognize not only their own problems but those of subordinate engineers and do whatever they possibly can to assist in the solution of these problems.

Many problems are the result of failure of the engineers in public practice to utilize procedures and devices available to them. Problems can be properly solved only if the avenues and opportunities that are open to us are utilized. All engineers in public practice should actively support their own employee organizations, taking proper steps to secure adequate representation for the engineers in the policy-making of such organizations, even if--or possibly, particularly if—it requires their services on committees of the organization or as a member of the Board of Directors. Such organizations will represent the engineers—the engineers must see that they are properly represented.

The recent interest in engineers on an international scale gives an opportunity such as has never been had before to present the problems of engineers, knowing they will receive consideration. But this same international interest means that these problems must be presented in a manner that will not detract from the dignity of the engineering profession.

Journal of

PROFESSIONAL PRACTICE

Proceedings of the American Society of Civil Engineers

CONTENTS

DISCUSSION

Page

Professional Earnings and Satisfaction Survey of Civil Engineers: Report of the Junior Activities Committee, Kansas City Section, ASCE. (Proc. Paper 1486, December, 1957. Prior discussion: 1883. Discussion closed.)
Closure by Committee. 29

Pity the Poor Professors—or Propagate Them! by J. E. McKee. (Proc. Paper 1870, December, 1958. Prior discussion: none. Discussion closed.)
by V. L. Streeter 31

Importance of Emphasis in Civil Engineering Education, by L. E. Grinter. (Proc. Paper 1871, December, 1958. Prior discussion: none. Discussion closed.)
by V. L. Streeter 33

Sputniks, Flopniks, and Engineering Education, by C. Ken Weidner. (Proc. Paper 1872, December, 1958. Prior discussion: none. Discussion closed.)
by F. C. Lindvall 35
by L. E. Grinter. 35

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PROFESSIONAL EARNINGS AND SATISFACTION SURVEY OF CIVIL ENGINEERS: REPORT OF THE JUNIOR ACTIVITIES COMMITTEE, KANSAS CITY SECTION, ASCE[a]

Closure by the Committee

CLOSURE BY THE COMMITTEE.—The interest shown by Mr. McKee in the results of our survey is gratifying. In view of his comments, it would appear that some additional discussion of the survey and its results, in the original paper, would have been beneficial to the reader.

The report of $9140 as the average salary was intended to be only a statement of fact. The primary purpose for its inclusion was to provide a basis for evaluation of the answers to question #12, "How much do you think you should be earning based upon your experience and qualifications?" The answer, an average of $10,625, may be interpreted to indicate that, on the average, the engineers surveyed believe the quality of their work justifies a 16% increase in salary.

The writer agrees that the median salary, which was about $7100, is more indicative of the salary structure revealed by the survey than the average salary. The division of salary ranges was adequate for the purpose of the survey—to reveal any conditions which might promote establishment of unions. In this respect, a small salary range above $7500 was not considered pertinent. It must be emphasized, however, that the reported median salary might be low due to the fact that the questionnaire was not designed for management and administrative personnel and, consequently, a very small return was realized from this relatively high income group.

Investigation of additional sources of salary survey information reveal interesting comparisons.

Reference to the January 1957 issue of Civil Engineering, p. 79, will permit comparison of the subject survey with one conducted in San Francisco about the same time. The average engineer, according to our survey, was 32 years old and had just under ten years experience. Fig. 1 of the article in Civil Engineering shows the salary for a man with this experience in the San Francisco Area to be about $7250.

On p. 79 on the September 1958 issue of Civil Engineering the results of the 1958 Employment Questionnaire, distributed by the ASCE Committee on Employment Conditions, are tabulated. The answers to question #7 relate the division of employment to each ASCE classification. Applying the starting salaries for each classification as indicated on p. 79 of the July 1957 issue of Civil Engineering to these numbers and adjusting the average downward by 7% reflect the lower 1956 salaries, it is found that the average salary is $7300.

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a. Proc. Paper 1486, December, 1957, by the Junior Activities Committee, Kansas City Section, ASCE.

A publication by NSPE, "Income and Salary Survey" for 1954-55, lists in Appendix Table 10, p. 32, a median salary for an engineer with 10 years experience of $7410 and a median salary of $6980 for a civil engineer with 10 years experience in Appendix Table 12, p. 34. "Professional Income of Engineers, 1956," Report No. 102 by the Special Surveys Committee of EJC, shows on p. 13, a median income for all engineers with 10 years experience of $7875. An approximate median 1956 salary for civil engineers with 10 years experience would then be $7875 ($6980/$7410) = $7400.

It must be concluded then from these examples that the Kansas City Area was about average for salaries paid in 1956.

It is unfortunate that, whenever salary surveys are reported, the first comparison is with the wages of labor. Mr. McKee compares the median salary with the wage of a bricklayer in the Kansas City Area. He does not, however, mention that this is the highest paid trade in the area. Any such comparison ignores the wages of the apprentice and the fact that all union bricklayers are limited to that salary as a top wage.

The engineer has more of a future than a salary increase of several cents an hour each year which must be squeezed out of employers by pressure. Investigation of Fig. 1, age vs. salary according to registration status, indicates a salary of about $7500 for the registered engineer at age 32 (the median age). This curve also indicates a salary of $10,000 at age 42 and the rate of increase is rapidly rising. It is misleading, therefore, to isolate the median salary for basis of comparison; much better procedure would involve computation of total earnings over a given number of years.

If there is unrest in the profession of a kind upon which unions will capitalize, it is because the young engineer has not been adequately informed as to the necessity of his "apprenticeship" in the profession. If such apprenticeship is longer than that of the bricklayer, it is because the tools of the profession are of a mental, not physical, nature and because proficiency in their use is required, not just desired.

Engineering is an exacting profession demanding that a high degree of competence be a prerequisite for success and recognition. It is certainly doubtful that such competence can be developed through organization or legislation offered by pressure groups.

PITY THE POOR PROFESSORS—OR PROPAGATE THEM![a]

Discussion by V. L. Streeter

V. L. STREETER,[1] M. ASCE.—The author is to be commended for his objective presentation of teaching of engineering as a profession. The press abounds with studies and opinions that the teaching profession is greatly underpaid. The author demonstrates by quoting reliable studies, however, that this is not so for the engineering teacher. With his extra remuneration for consulting, summer work, and other professional activities, the median engineering salary and average college engineering salary are about the same.

Teaching, as a way of life, has many advantages:

1. Except for a reasonable number of hours a week while actually in class, the teacher may organize his working schedule as he pleases. After meeting classes and preparing for them, he will generally have time to devote to his further education, through study, research, or consulting. Some teachers even find time in the late afternoon for a game of golf!
2. Living conditions in a college town are usually simpler and much more pleasant than in an industrial community. The atmosphere is stimulating—colleagues are a well-informed, intelligent, well-traveled group. Cultural opportunities abound in the college town, with lectures, plays, and concerts reasonably priced. There is generally no commuting and walking to work may be practical. It is the ideal community in which to raise a family.
3. The teacher is under less tension than his counterpart in industry. One does not feel that his brain is being "picked" in a college community—in fact, quite the opposite, as one is storing up more fundamental knowledge and making it a working tool by everyday application.
4. Education and travel are both actively encouraged and made more convenient and enjoyable when one has a college connection. The sabbatical, or "refresher" leave permits travel and residence away from home, and may be supplemented by other awards or grants from private or government sources. One has the additional advantage of contacting former students who are genuinely interested in renewing contacts and in informing the teacher regarding his activities and his locality.
5. There is much personal satisfaction in working with a student over a period of time, in observing and aiding in his professional growth. This is particularly the case with graduate students where student and teacher work together on research and design problems. The teacher, however, should teach undergraduate work and try to select the most

a. Proc. Paper 1870, December, 1958, by J. E. McKee.

1. Prof. of Hydr., Univ. of Michigan, Ann Arbor, Mich.

promising students then for encouragement toward graduate work and the teaching profession.

To sum up, as a way of life, college engineering teaching gives more opportunities to grow professionally and is more rewarding than other forms of engineering activity. The prospective teacher is recommended to read "College Teaching as a Career", American Council on Education, 1958.

IMPORTANCE OF EMPHASIS IN CIVIL ENGINEERING EDUCATION[a]

Discussion by V. L. Streeter

V. L. STREETER,[1] M. ASCE.—Professor Grinter is to be commended for strongly presenting the immediate and pressing need for civil engineering staffs to study their curricula. The writer believes that civil engineering educators should move toward the "C" curricula of Table I as soon as practicable.

While some other departments of engineering colleges have been stressing fundamentals and have been building strongly on the physical and engineering sciences, the civil engineering educators have stated that they are "different" and that the employers of their graduates insist that the man with a bachelors degree be competent in surveying, drafting, structural detailing and other sub-professional skills. The civil engineers are very proud of their "broad" program.

The need for building on physical and engineering sciences is recognized by the Education and Accreditation Committee of the Engineer's Council for Professional Development, as one basis for accreditation is "Progression of courses and manner in which fundamental scientific training of the earlier years is carried into the teaching of the later engineering courses."

The slow gain in civil engineering enrollments, as compared with other branches, must be attributed in part to the educational program and in part to the job opportunities offered. As long as we continue to graduate students long on skills and short on fundamentals, employers will utilize them in sub-professional work—a wearisome and difficult situation for advancement. If their sights are raised by training them in the humanities, in physical and engineering sciences, and in analysis, synthesis and design, they will leave college with the best possible background for growth. They will be less "comfortable" and less "useful", perhaps, in the first few months of employment, but with their strong background they will easily acquire the skills needed, and in a form preferred by their employer. The "art" or "practice" omitted in the new curriculum will be acquired by the young engineer on the job, by studying and by more general reading, and by contact with professional engineers. If an engineer considers his education completed upon leaving college, he will have difficulty in rising from the sub-professional level.

Students of high quality are not being attracted into civil engineering in the proper proportions. This is partially due to the glamour of electronics and astronautics, but is also due to the very tight, cluttered, and superficial curriculum offered to the civil engineering students. Many of the skill courses, all of the survey-type courses, all of the practice courses, and some of

a. Proc. Paper 1871, December, 1958, by L. E. Grinter.

1. Prof. of Hydr., Univ. of Michigan, Ann Arbor, Mich.

the design work that is tied closely to codes should be stripped from the curriculum. A couple of semester-hours of reading courses with a final examination could orient the student to practical phases of civil engineering without use of class time. Work from the fields of mathematics, physics, chemistry, bacteriology, mechanics, electrical theory, thermodynamics and rate processes should be added so that the student can approach synthesis and design with the fundamentals to think creatively. With several hours of free electives remaining in the curriculum, this program should be attractive to the better student entering engineering.

In many present civil engineering departments changes as outlined would cause a major upheaval. Time must be taken for staff re-education, as many civil engineering staff members have lost their ability to use mathematics, mechanics, and analysis. An immediate effort should be made by the individual teachers and the college administration to remedy this deficiency. With the whole staff of a department working together to improve the curriculum, and with each staff member analyzing his own courses and his own educational requirements, within five years civil engineering educators should be turning out graduates with a professional growth potential second to none.

SPUTNIKS, FLOPNIKS, AND ENGINEERING EDUCATION[a]

Discussions by F. C. Lindvall and L. E. Grinter

F. C. LINDVALL.[1]—The paper by C. Ken Weidner has vital significance, devastating implications and a challenge to action which should not be ignored. The elemental significance of the observations he makes and the conclusions he presents make a deep impression. No one who has been privileged to visit the Soviet Union and to study its current engineering education can read Dean Weidner's paper without a fervent Amen! The implications of the Russian engineering and science education, the momentum of their economy, the first and second derivatives of significant indices of all types are challenges of the first magnitude which surely must dent our comfortable complacency.

Let there be no quibble with Weidner over the "Christian" ideal which could, with misguided emotion, negate the sacred American tenet of religious freedom; rather let concern be only with the broadest values. Let there be no argument over details of Russian adoption of the "educational concept" of the United States study of medicine. Nor should a scholarly discussion of the merits or limitations of the specialized engineering curricula in the U.S.S.R. be a diversion from the central issues. Instead, the focus of attention should be on the substance of the challenge to the democratic way of life and the educational implications, rather than on details which could obscure the painful truths of the central lesson.

As Weidner suggests, the democratic society must be disciplined to the superficial and the painful sacrifices necessary in order to win the world-wide "struggle for mens' minds and souls". Science, Engineering, Technology, Moral Values, can implement the efforts to aid the countries of the world less favored than the United States in resources and opportunities.

Engineers pride themselves on being realistic. Nothing is more real than the basic ideas and the uncomfortable observations which thread in and out of the Weidner tapestry. This story should go far beyond the limited circle of those who are attracted by the somewhat trivial title.

L. E. GRINTER,[2] M. ASCE.—When Mr. Weidner states that the Cold War is a war of extinction he only places due emphasis upon a simple truth that should be but is not obvious as yet to the American people. If it were obvious we could not be facing a period of great prosperity without an increase of taxes needed to fight this new kind of war. In his list of attitudes of thoughtful

a. Proc. Paper 1872, December, 1958, by C. Ken Weidner.

1. Chairman, Division of Civil, Electrical, Mechanical Engineering and Aeronautics, California Inst. of Technology, Pasadena, Calif.
2. Dean, Graduate School, Univ. of Florida, Gainesville, Fla.

foreigners toward our national procedures the author gives a very clear explanation of what the Cold War tries to accomplish. "Instead of seeking out the enemy's forces and destroying them, the Russian approach is to maneuver and encourage the enemy to destroy himself by exhausting his natural resources and dissipating his wealth and power in countering widely scattered military threats while the Russian ideology is sold . . . from within." Along with Quemoy, Lebanon, and Berlin we must add sputnik and lunik as cold-war diversions. Although satellites will doubtless be used to investigate weather and to radiate communications around the world, these are more important peace-time than military activities. For observation of enemy territory we have much more to gain than Russia by establishing television cameras in the sky. Hence, I believe sputnik was and other satellites will be cold-war propaganda which we should assess at their real value while reacting to our best advantage without scare or scurry.

If we assay our capacity to compete with Russia in a Cold War it seems clear that the author's emphasis upon education in America is well placed. Since true education must go beyond the technical, American higher education is richer in values than the Russian even in our present state. We know, or should know, that Russian education is scientifically excellent. It is no happenstance that Timoshenko remade American education in mechanics and that Bakhmeteff had such an important influence upon the teaching of hydraulics. These men brought an understanding of mathematics and physics to solid and fluid mechanics. We cannot yet equal Russian ingenuity in this direction. However, we are engaged in a struggle for men's minds which will be influenced not only by mechanics and hydraulics but by ethics and philosophy. Our educational system is a better one than the Russian as a base for an important educational advancement. Our problem is one of understanding the strategic importance of education in the Cold War so that it may be supported in part as an extraordinary activity at least equal in its significance to foreign aid. When so recognized it seems clear that some of the biological concepts of "natural selection" will automatically be applied to the selection of students and teachers. Also, although mathematics and science should be emphasized, these studies will have to be balanced with a humanistic study of equal rigor concerning man and his environment, including his many tongues. The author doubtless includes these factors in his term "moral socio-political maturity." We should produce as many engineers and scientists as we need to advance our own economy and to aid our allies. The number is controllable by fellowship support which is a fully legitimate use for Cold War funds. We can also control the number of students trained for research in our graduate schools in the same manner at least up to a number that is perhaps three or four times our present ratio of doctrates to baccalaureate degrees.

The author makes a plea for change in engineering curricula on the basis of an experiment that may not be very broadly applicable in the USA. However, he makes several important points. We have been too inclined to analyze our curricula by comparing them with a hundred others which results in emphasizing the mean. It should be clear that this procedure is a perfect device for perpetuating the mediocrity of the past into the future. Instead, engineering education needs to set as its objective the production of more highly creative engineers. Creativity can be applied by many more engineers in the fields of physical science research, but some creative engineers are equally needed in inter-disciplinary areas between engineering and economics, engineering and politics, engineering and international law, etc., etc.

Journal of
PROFESSIONAL PRACTICE
Proceedings of the American Society of Civil Engineers

COMMITTEE ON ENGINEERS IN PUBLIC PRACTICE

M. J. Shelton,[1] M. ASCE

FOREWORD

At the February 1959 ASCE Convention in Los Angeles, Calif., a symposium was presented on the topic of Engineers in Public Practice, at State and Local Levels under the auspices of the Committee on Engineers in Public Practice. These papers have been published as follows:

Committee on Engineers in Public Practice by M. J. Shelton (Proc. Paper 2046 in the May 1959 Journal of Professional Practice).

Problems of Engineers in State Civil Service by Robert F. Gray (Proc. Paper 2047 in the May 1959 Journal of Professional Practice).

Problems of County and Municipal Engineers in Civil Service by Jean Vincenz (Proc. Paper 2029 in the May 1959 Journal of Professional Practice).

Ethics in Public Practice by R. Robinson Row (January 1959 Civil Engineering, p. 33).

ABSTRACT

The Committee, constituted by Board action in October 1957, participated at its first Convention Session at Los Angeles in February. A resume was given as to the formation, aims and objectives of the Committee followed by a discussion of a few of the actions to date and problems being considered.

Approximately 40% of the civil engineers in the United States practicing in the civil engineering profession are employed by local, state or federal levels of government. Such levels of employment are more seriously affected by

Note: Discussion open until October 1, 1959. Separate discussions should be submitted for the individual papers is this symposium. To extend the closing date one month, a written request must be filed with the Executive Secretary, ASCE. Paper 2046 is part of the copyrighted Journal of Professional Practice, Proceedings of the American Society of Civil Engineers, Vol. 85, No. PP 1, May, 1959.

1. Chf. Engr., San Diego Office, Koebig and Koebig, Cons. Eng.-Architecture, Los Angeles, Calif., and Chmn., Committee on Engineers in Public Practice.

economic conditions than is true in other forms of employment due in large part to the time lag in effecting increases. This has resulted, generally speaking, in lower salaries, greater compression of salaries at the higher levels and retarded advancement to higher levels of position. This has brought about a movement of government employed engineers to other employment, principally with private engineering firms or industry. The situation has been true for such a length of time that the various levels of government are finding it increasingly more difficult to maintain, let alone expand, their public services. This has been brought to the fore more recently by government's inability to compete for the recruitment of graduates or other young engineers. The proportion of young men studying civil engineering in comparison with other branches of engineering has been steadily declining, probably in no small measure because of inadequate salaries or opportunities.

This situation was recognized by the Board of Direction of the American Society of Civil Engineers when, at its October 1957 meeting it appointed a newly constituted committee, namely, Committee on Engineers in Public Practice. The duties are set forth in a new section of the Bylaws of the Society which has become Article VII, Section 4(j) which reads, in part: "The Committee on Engineers in Public Practice, which shall maintain continuing study of problems affecting engineers in all branches of public employment, and shall make recommendations, from time to time, with respect to actions which may be appropriate for improving the effectiveness of Federal, State or Municipal civil service, military or other public employment."

Analysis would indicate that those in responsible charge in the various branches of public employment have quite generally recognized the seriousness of the situation. It is quite possible that such individuals and their policy making bodies are in need of basic data which may be used in support of requests for corrective action. The declared policy of the ASCE Board of Direction is that the Society, through its individual members, Local Sections and as a National Society shall assist in the collection of such basic data, making it available when and where needed. Conditions vary considerably over the country and from one form of public employment to another. This then would indicate that a substantial participation in this effort must necessarily be at the Local Section level.

An employer should:

a. Desire to retain a competent force, minimizing resignations.
b. Give the maximum service for the minimum dollar investment. To do so requires that the engineer have an adequate education and experience commensurate with the work assigned him making unnecessary the assignment of more highly qualified and paid men to accomplish that work.
c. Procure the best personnel obtainable.
d. Provide a reasonable incentive program.

The following principles can well be applied in accomplishing the above:

a. Develop uniform, minimum requirements for each classification level.
b. Establish clearly defined responsibilities on a progressive scale as between classification levels and commensurate salaries.
c. Establish a realistic program of "fringe benefits" recognizing what industry and private practice is doing in this field.
d. Require State registration for all classifications having responsibility and/or supervision of other engineers.

e. Recognize professional interest as shown by membership in professional societies, technical activities, etc.
f. Develop a program whereby the employee is encouraged to improve himself professionally through study-in-employment, self-study, graduate work and participation in professional activities such as writing of papers and presentation of papers before professional groups thereby facilitating the exchange of ideas which will directly benefit the employer.
g. Recognize length of service.

Procedures should be established which will assure, even through changing economic conditions, that there is:

a. Ample salary range within each classification level.
b. Ample spread between classifications to preclude compression.

Referring to general comments above, many employers have need for basic data if they are to accomplish the principles and objectives outlined. There is need for the collection of such data initially, as well as to maintain such data on a current basis. Data must necessarily cover all forms of employment of a comparable nature, whether public or private employment.

Analysis of the above by the Committee on Engineers in Public Practice led to the committee recommendation that Secretary Wisely address a letter to each Section advising of the formation and activity of the Committee and suggesting that a similar committee be activated at the Local Section level if not now existent. Many such committees are now at work and more are being activated.

There are many questions as to how best collect the basic data; a few such questions follow:

a. Should this be done by each agency? It would hardly seem so because of the resulting duplication of effort.
b. Should this be done by Engineers Joint Council, divided into regions where there now exists a form of local joint council?
c. Should this be done by one or more outside interests, such as Engineering News Record does as to wages, material and construction costs?
d. Should this be done by a federal agency such as the Department of Labor:

    1. For Federal use only?
    2. For State and Federal use?
    3. For use of all public agencies?

Within the various groups of public agencies, can use be made of existing regional, state or national groups to obtain the maximum coordination and benefit? Examples of such groups are:

a. State Leagues of Municipalities.
b. County Supervisors Associations.
c. Association of State Engineers.
d. Association of State Highway Officials.
e. Various associations related to the engineering profession.

Possibly some of the Local Section Committees will consider these and other questions and submit their ideas to the National Committee on Engineers in Public Practice. Such information would greatly assist the Committee

in more rapidly embarking on a program which could well benefit a vast number of engineers in public practice. Several actions have been taken during the Committee's first year; many of these have been in the form of resolutions, approved by the Board of Direction and given wide publicity and distribution.

The Committee is most pleased to have the opportunity of presenting a panel today that the membership may learn something of the problems of the engineer in public practice. Through such presentations, assistance from the Local Sections and study by the national Committee, it is hoped that the American Society of Civil Engineers will be able to encourage public agencies in bettering the professional status of the engineer.

Journal of
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PROBLEMS OF CIVIL ENGINEERS IN STATE CIVIL SERVICE

Robert D. Gray[1]

FOREWORD

At the February 1959 ASCE Convention in Los Angeles, Calif., a symposium was presented on the topic of Engineers in Public Practice, at State and Local Levels under the auspices of the Committee on Engineers in Public Practice. These papers have been published as follows:

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The California State Personnel Board which administers the civil service system in this State is aware of some of the problems of engineers in public practice. Here are a few selected quotations from pages 2 and 4 of the report of the Board dated December 5, 1958, to the Governor and to Members of the Legislature:

> Many changes are continuing to occur in State Government. The most obvious, and one which also produces other changes, is its growth . . . The 18,286 employees in State Government in 1935 had increased by June 30, 1958, to 88,665, not including those of the University of California.
>
> This growth has resulted not only from California's rapidly expanding population but also because of additional services provided by State

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1. Director, Industrial Relations Section, California Inst. of Technology, and Pres. California State Personnel Bd., Pasadena, Calif.

agencies and new concepts of existing services. The enlargement is illustrated by the broadening programs for freeway planning and construction and water resources development . . .

As State services grow in size and complexity, the demand for professional and technical personnel increases more rapidly than for other types of employees . . .

. . .

The basic problem is to find competent employees with special skills. It is especially difficult to recruit . . . hydraulic, highway, and bridge engineers . . . The demand for individuals in these occupations outruns the supply and will continue to do so in the foreseeable future. The supply of civil engineers, and this is the specialty most used by the State, will benefit only slightly from the increased emphasis upon engineering in the schools because the current interests among these students are in the fields of aeronautical, jet propulsion, electronic, atomic, and astronautic engineering.

. . .

In the first half of 1958, the in-state and nationwide recruitment program for Junior Civil Engineer, the chief entry class for engineers, resulted in the placement of 410 graduate engineers. The State must continue its present level of recruitment to maintain the working force of 5,000 engineers required in its highway construction, water resource development, and other programs. The supply of civil engineers is already short and is expected to become shorter because of the high level of construction and the nationwide emphasis on highway building programs.

This concludes the statements that I shall give reflecting the views of all of the Members of the State Personnel Board. In the balance of the paper, I express only my personal beliefs. After listening for almost 15 years to engineers appearing before the Board to give their opinions, I appreciate this privilege of appearing before engineers to share my opinions with you.

In addition to my State experience, I have studied personnel problems in various industries, both before and during my 18 years at Caltech. One major activity for the past six years has been the study and discussion of various problems of supervision of scientific and engineering personnel. During the past two years alone, I have met in small groups over a thousand supervisors of engineers from a variety of companies, although most of them have been in the aircraft, missile, and related fields.

Perhaps it is because of this combination of experience that I have noticed some ambiguity in the title of this paper, "Problems of Civil Engineers in State Civil Service." The scope and intent could be clarified by expressing the subject as either "Problems Faced by Civil Engineers in State Civil Service" or "Problems Caused by Civil Engineers in State Civil Service."

As an indication that civil engineers are not really different from other engineers or from other employees, I am sure that all of you interpreted the title of this paper to be "Problems Faced by Civil Engineers in State Civil Service." For your benefit, therefore, I shall list an even dozen problems in alphabetical order: (1) benefit plans, (2) development or training, (3) employment, (4) facilities, (5) organization of work, (6) personal problems, (7) professional status, (8) promotion, (9) salary, (10) supervision received, (11) type of work, and (12) working conditions. Each of these twelve can, of course, be divided into additional and more specific problems.

Although you may never have thought about this paper as a discussion of problems caused by civil engineers in State civil service, I am sure that by this time you are curious about such an interpretation of the subject. Curiosity is an important trait in civil engineers and in other engineering, scientific, and professional employees. To satisfy your curiosity, let me give you another list of twelve problems caused by civil engineers in State civil service: (1) abuse of equipment, (2) deviation from schedules, (3) disregard for regulations, (4) friction with non-engineers, (5) incompatible activities, (6) indifference to public opinion, (7) jargon in reports, (8) lack of cooperation, (9) over-engineering, (10) overrun on costs, (11) overspecialization, and (12) turnover. These problems also arise from other engineers and, with some modifications, from other employees in civil service and in private employment.

My first list of problems faced by civil engineers undoubtedly struck some responsive chords in each of you. The second list of problems caused by civil engineers does not apply to anyone here since "those who need to be saved do not go to prayer meetings," but perhaps you were reminded of an occasional civil engineer who might be guilty of causing such problems.

By giving both of these lists in alphabetical order, I have clearly demonstrated that I am not an engineer. No engineer would use an arbitrary, alphabetical arrangement in presenting a list of problems. It is obvious to any engineer that such a list should be presented in order of importance.

I wish that there were time today for each of you to put in rank order the list of twelve problems faced by civil engineers in State civil service, and, I might add, twelve problems faced by engineers everywhere and, with slight modification, problems faced by all employees. If such an experiment could be tried, you would discover for yourselves that the relative importance of these problems depends upon the specific unit in State service in which a person is employed and, in even greater degree, upon the individual himself.

This importance of the individual must be recognized and appreciated by engineers if they are to understand the difference between engineering problems and personnel problems. In solving engineering problems, it can be assumed safely that materials, equipment, or processes conforming to the same specifications will produce similar results or behave in the same manner. A factor of safety can always be included also. On the other hand, even if two individuals seem to meet the same specifications, and this is difficult to achieve, it is unlikely that they will react in exactly the same way. In fact, the same individual often reacts differently at different times.

Problem of Pay

From what I have heard and what I have read, I am convinced that civil engineers in the California State Civil Service feel that they have a problem of pay. Some of you may be tempted to send that sentence to The New Yorker for its "Department of Understatement."

It should be apparent to civil engineers that during and since World War II the problem of pay has become the most general and most widespread personnel problem. Unfortunately, almost every person feels that pay is his individual problem. Here are a few illustrations of the universality of pay problems:

(a) The California State Employees Association recently informed the State Personnel Board officially that all civil service employees required an increase in pay as of January 1, 1959.

(b) I have not talked with any engineers employed by the City or County of Los Angeles recently, but there may be some in the audience today. Even though an increase in salaries became effective as recently as November 30, 1958, for City employees and January 1, 1959, for County employees, I am confident that most of them still feel that they have a salary problem.

(c) In opinion polls, which have been made by the Industrial Relations Section of the California Institute of Technology and by other agencies, engineers in private industry have indicated that they, too, have a salary problem. The same report was made by employees in general.

(d) Everyone who reads more than the sports pages and the comics in the daily newspapers must be aware that there have been pay problems in practically every industry and every occupation. Airline pilots, who get more than civil engineers, have indicated that they have a pay problem. The pay problems of grocery clerks have been on the front pages of Los Angeles newspapers for some time. The "help wanted" ads are frequently cited as indications of pay problems. Even those whose newspaper reading is confined to the sports pages may have noticed that pay problems are headlined there also for professional athletes and coaches.

Pay means different things to different persons. Many think of pay as that little amount left in the pay check after an increasing number and amount of deductions have been made. Others regard as pay the actual rate or salary discussed in employment and salary adjustment interviews and also reported for income tax purposes but no longer seen by anyone. Some define pay as the total financial compensation received for work: salary plus benefit plans plus bonuses and other current and deferred payments to, or on behalf of, the employee.

Even when there is agreement as to the concept of pay being discussed, it is hard to compare the salaries paid by different employers. Any salary survey is difficult to make, and a salary survey of engineering positions is especially difficult. Comparisons of "take-home pay" are usually meaningless. Surveys of total compensation received are practically impossible to make because of the varied conditions and differences among individuals, industries, and governmental agencies. It is obvious, for example, that civil engineers and other employees of the State of California, or of any other governmental jurisdiction, cannot participate in profit-sharing or employee stock-ownership plans, which are growing in private industry. State employees cannot look forward to stock options or other forms of capital gains. These limitations on total financial compensation also apply to engineers and other individuals employed by nonprofit organizations. There is certainly nothing unique in the California State Civil Service system in this respect.

The last salary increase received by civil engineers in the California State service was effective July 1, 1957. Since that time, the federal government, most of the states, and most of the cities and counties in California have granted salary increases. Practically every major industry has granted one increase, and many of them have granted two increases. The California State Personnel Board has recommended a salary increase to be effective July 1, 1959, if funds are appropriated for it.

The salary of civil engineers in the State service is not a secret or confidential item. This lack of secrecy on civil service salaries is true for all

employees in the State service and also in other civil service agencies. In private industry, on the other hand, rates of pay may not be confidential for employees in a bargaining unit. The salaries of the top executives in corporations listed on the stock exchange are not secret. Salaries of individual engineers in private industry, however, are usually regarded as secret or confidential. Many private employers will not even tell an engineer what the minimum or maximum amount for his classification is. This veil of secrecy may be a problem to engineers in private industry just as the lack of secrecy may be a problem to civil service engineers.

Another problem of pay in civil service is the relatively narrow range in salaries for a given level of engineering work. In the State civil service, for example, the typical range is 21% from the minimum to the maximum. In other words, the highest paid junior, assistant, or associate engineer gets about 21% more than the lowest paid engineer in the same class. In private industry, on the other hand, the range is frequently from 30% to 50%.

The real problem however is not with this difference in width of salary ranges. In fact, the difference in width of salary ranges may be attributed to other differences between the administration of salaries in civil service and in private industry. In most civil service agencies, and certainly in the State civil service, the increase from the minimum to the maximum is practically automatic. An individual must receive a report of performance indicating that his work is below standard or unacceptable to block this annual increase step by step to the maximum. Very few employees receive adverse ratings. The law, in one place at least, refers to these as "automatic" increases. While it is theoretically possible for an individual to miss his automatic increase between the minimum and the maximum of his salary range, it is practically impossible for him to advance more rapidly.

As a student of wage and salary administration, I can accept the procedure of automatic increases for many positions, especially those at the lower end of the wage or salary scale and those in which the individual has relatively little control over his output. In engineering, professional, and managerial positions, however, I feel that the output of an individual is largely determined by his abilities and efforts. There is, therefore, a need for a real incentive, and reward, for outstanding production. Many employers in private industry administer salaries for professional and administrative personnel to give an incentive for outstanding performance and a reward for outstanding performance. The basing of salaries on merit rather than on longevity is also necessary if internal relationships of salaries are to be in accord with the professional achievements and contributions of various engineers.

Private industry accepts the facts of life that different groups of jobs require different methods of wage and salary administration. State civil service on the other hand administers the salaries of a Junior Clerk and the State Highway Engineer in exactly the same manner. The correction of this requires legislation, and appropriate legislation requires that State employees, and especially engineers, develop confidence in the integrity of their supervisors. Supervisors must earn this confidence.

One reason why pay is such a widespread problem is that all too frequently it is used to disguise the real problem. Many individuals and even groups of individuals feel that they have a problem with working conditions, with the type of supervision received, or with the lack of professional status, to give a few examples. Instead of trying to solve the specific problem which troubles them, they develop a feeling that an increase in pay would compensate for the

lack of facilities or the poor working conditions or the inadequate supervision. Unfortunately, however, increased pay does not solve these problems. After only a short while, the individuals again become dissatisfied and may seek another increase in pay instead of a correction of the basic problem.

Time does not permit a complete analysis of the pay problem. The concept of total compensation must include an appraisal of benefit plans in terms of the cost to the employer and the employee and in terms of the protection and value received by both the employer and the employee. Finally, I want you to know that I realize that financial compensation is not the only goal of civil engineers or other employees in State civil service or elsewhere.

To encourage discussion of other problems, I shall mention two more: opportunity for advancement and incentive.

Opportunity for Advancement

In State service, advancement is primarily dependent upon the rating achieved in a competitive examination which may be written, oral, or a combination of these methods. Pull, influence, and seniority have less influence in civil service than in some private employment. On the other hand, however, advancement cannot be used in civil service as a reward for outstanding accomplishment. The fact that an individual has demonstrated unusual ability on the job cannot by itself secure a higher job for him.

Incentive

The State civil service system and civil service in general have difficulty in providing incentives. It is obvious that from a point of view of financial compensation the State cannot provide profit-sharing, bonuses, employee stock-ownership, or other programs which might result in capital gains rather than income. It has been indicated that salary increases in State civil service cannot be administered under the present law to provide an incentive. Promotions cannot be used as incentives. The challenge for the future is to develop incentives and rewards for engineers and others in State civil service. Treating everyone the same is not equitable unless everyone deserves and earns the same treatment. Different treatment is justified for different conditions and performance.

CONCLUSION

We need to develop, first of all, a philosophy that the objective of State civil service should be to encourage the selection and development of individuals so that their abilities, knowledges, and skills can be used for the mutual advantage of society as a whole, government, and the individuals themselves. The techniques to achieve this objective can then be developed and applied. Such an approach will solve at least some of the problems faced by civil engineers in the State civil service.

PROCEEDINGS PAPERS

The technical papers published in the past year are identified by number below. Technical-division sponsorship is indicated by an abbreviation at the end of each Paper Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Pipeline (PL), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways and Harbors (WW), divisions. Papers sponsored by the Department of Conditions of Practice are identified by the symbols (PP). For titles and order coupons, refer to the appropriate issue of "Civil Engineering." Beginning with Volume 82 (January 1956) papers were published in Journals of the various Technical Divisions. To locate papers in the Journals, the symbols after the paper number are followed by a numeral designating the issue of a particular Journal in which the paper appeared. For example, Paper 1859 is identified as 1859 (HY 7) which indicates that the paper is contained in the seventh issue of the Journal of the Hydraulics Division during 1958.

VOLUME 84 (1958)

MAY: 1621(HW2), 1622(HW2), 1623(HW2), 1624(HW2), 1625(HW2), 1626(HW2), 1627(HW2), 1628(HW2), 1629 (ST3), 1630(ST3), 1631(ST3), 1632(ST3), 1633(ST3), 1634(ST3), 1635(ST3), 1636(ST3). 1637(ST3), 1638(ST3), 1639(WW3), 1640(WW3), 1641(WW3), 1642(WW3), 1643(WW3), 1644(WW3), 1645(SM2), 1646(SM2), 1647 (SM2), 1648(SM2), 1649(SM2), 1650(SM2), 1651(HW2), 1652(HW2)[c], 1653(WW3)[c], 1654(SM2), 1655(SM2), 1656(ST3)[c], 1657(SM2)[c].

JUNE: 1658(AT1), 1659(AT1), 1660(HY3), 1661(HY3), 1662(HY3), 1663(HY3), 1664(HY3), 1665(SA3), 1666 (PL2), 1667(PL2), 1668(PL2), 1669(AT1), 1670(PO3), 1671(PO3), 1672(PO3), 1673(PL2), 1674(PL2), 1675 (PO3), 1676(PO3), 1677(SA3), 1678(SA3), 1679(SA3), 1680(SA3), 1681(SA3), 1682(SA3), 1683(PO3), 1684 (HY3), 1685(SA3), 1686(SA3), 1687(PO3), 1688(SA3)[c], 1689(PO3)[c], 1690(HY3)[c], 1691(PL2)[c].

JULY: 1692(EM3), 1693(EM3), 1694(ST4), 1695(ST4), 1696(ST4), 1697(SU2), 1698(SU2), 1699(SU2), 1700(SU2), 1701(SA4), 1702(SA4), 1703(SA4), 1704(SA4), 1705(SA4), 1706(EM3), 1707(ST4), 1708(ST4), 1709(ST4), 1710 (ST4), 1711(ST4), 1712(ST4), 1713(SU2), 1714(SA4), 1715(SA4), 1716(SU2), 1717(SA4), 1718(EM3), 1719 (EM3), 1720(SU2), 1721(ST4)[c], 1722(ST4), 1723(ST4), 1724(EM3)[c].

AUGUST: 1725(HY4), 1726(HY4), 1727(SM3), 1728(SM3), 1729(SM3), 1730(SM3), 1731(SM3), 1732(SM3), 1733 (PO4), 1734(PO4), 1735(PO4), 1736(PO4), 1737(PO4), 1738(PO4), 1739(PO4), 1740(PO4), 1741(PO4), 1742 (PO4), 1743(PO4), 1744(PO4), 1745(PO4), 1746(PO4), 1747(PO4), 1748(PO4), 1749(PO4).

SEPTEMBER: 1750(IR3), 1751(IR3), 1752(IR3), 1753(IR3), 1754(IR3), 1755(ST5), 1756(ST5), 1757(ST5), 1758(ST5), 1759(ST5), 1760(ST5), 1761(ST5), 1762(ST5), 1763(ST5), 1764(ST5), 1765(WW4), 1766(WW4), 1767(WW4), 1768(WW4), 1769(WW4), 1770(WW4), 1771(WW4), 1772(WW4), 1773(WW4), 1774(IR3), 1775 (IR3), 1776(SA5), 1777(SA5), 1778(SA5), 1779(SA5), 1780(SA5), 1781(WW4), 1782(SA5), 1783(SA5), 1784 (IR3)[c], 1785(WW4)[c], 1786(SA5)[c], 1787(ST5)[c], 1788(IR3), 1789(WW4).

OCTOBER: 1790(EM4), 1791(EM4), 1792(EM4), 1793(EM4), 1794(EM4), 1795(HW3), 1796(HW3), 1797(HW3), 1798(HW3), 1799(HW3), 1800(HW3), 1801(HW3), 1802(HW3), 1803(HW3), 1804(HW3), 1805(HW3), 1806 (HY5), 1807(HY5), 1808(HY5), 1809(HY5), 1810(HY5), 1811(HY5), 1812(SM4), 1813(SM4), 1814(ST6), 1815 (ST6), 1816(ST6), 1817(ST6), 1818(ST6), 1819(ST6), 1820(ST6), 1821(ST6), 1822(EM4), 1823(PO5), 1824 (SM4), 1825(SM4), 1826(SM4), 1827(ST6)[c], 1828(SM4)[c], 1829(HW3)[c], 1830(PO5)[c], 1831(EM4)[c], 1832(HY5)[c]

NOVEMBER: 1833(HY6), 1834(HY6), 1835(SA6), 1836(ST7), 1837(ST7), 1838(ST7), 1839(ST7), 1840(ST7), 1841(ST7), 1842(SU3), 1843(SU3), 1844(SU3), 1845(SU3), 1846(SU3), 1847(SA6), 1848(SA6), 1849(SA6), 1850(SA6), 1851(SA6), 1852(SA6), 1853(SA6), 1854(ST7), 1855(SA6)[c], 1856(HY6)[c], 1857(ST7)[c], 1858 (SU3)[c].

DECEMBER: 1859(HY7), 1860(IR4), 1861(IR4), 1862(IR4), 1863(SM5), 1864(SM5), 1865(ST8), 1866(ST8), 1867 (ST8), 1868(PP1), 1869(PP1), 1870(PP1), 1871(PP1), 1872(PP1), 1873(WW5), 1874(WW5), 1875(WW5), 1876 (WW5), 1877(CP2), 1878(ST8), 1879(ST8), 1880(HY7)[c], 1881(SM5)[c], 1882(ST8)[c], 1883(PP1)[c], 1884(WW5)[c], 1885(CP2)[c], 1886(PO6), 1887(PO6), 1888(PO6), 1889(PO6), 1890(HY7), 1891(PP1).

VOLUME 85 (1959)

JANUARY: 1892(AT1), 1893(AT1), 1894(EM1), 1895(EM1), 1896(EM1), 1897(EM1), 1898(EM1), 1899(HW1), 1900(HW1), 1901(HY1), 1902(HY1), 1903(HY1), 1904(HY1), 1905(PL1), 1906(PL1), 1907(PL1), 1908(PL1), 1909(ST1), 1910(ST1), 1911(ST1), 1912(ST1), 1913(ST1), 1914(ST1), 1915(ST1), 1916(AT1)[c], 1917(EM1)[c], 1918(HW1)[c], 1919(HY1)[c], 1920(PL1)[c], 1921(SA1)[c], 1922(ST1)[c], 1923(EM1), 1924(HW1), 1925(HW1), 1926 (PL1), 1927(HW1), 1928(HW1), 1929(SA1), 1930(SA1), 1931(SA1), 1932(SA1).

FEBRUARY: 1933(HY2), 1934(HY2), 1935(HY2), 1936(SM1), 1937(SM1), 1938(ST2), 1939(ST2), 1940(ST2), 1941(ST2), 1942(ST2), 1943(ST2), 1944(ST2), 1945(HY2), 1946(PO1), 1947(PO1), 1948(PO1), 1949(PO1), 1950(HY2)[c], 1951(SM1)[c], 1952(ST2)[c], 1953(PO1)[c], 1954(CO1), 1955(CO1), 1956(CO1), 1957(CO1), 1958 (CO1), 1959(CO1).

MARCH: 1960(HY3), 1961(HY3), 1962(HY3), 1963(IR1), 1964(IR1), 1965(IR1), 1966(IR1), 1967(SA2), 1968 (SA2), 1969(ST3), 1970(ST3), 1971(ST3), 1972(ST3), 1973(ST3), 1974(ST3), 1975(ST3), 1976(WW1), 1977 (WW1), 1978(WW1), 1979(WW1), 1980(WW1), 1981(WW1), 1982(WW1), 1983(WW1), 1984(SA2), 1985(SA2)[c], 1986(IR1)[c], 1987(WW1)[c], 1988(ST3)[c], 1989(HY3)[c].

APRIL: 1990(EM2), 1991(EM2), 1992(EM2), 1993(HW2), 1994(HY4), 1995(HY4), 1996(HY4), 1997(HY4), 1998 (SM2), 1999(SM2), 2000(SM2), 2001(SM2), 2002(ST4), 2003(ST4), 2004(ST4), 2005(ST4), 2006(PO2), 2007 (HW2)[c], 2008(EM2)[c], 2009(ST4)[c], 2010(SM2)[c], 2011(SM2)[c], 2012(HY4)[c], 2013(PO2)[c].

MAY: 2014(AT2), 2015(AT2), 2016(AT2), 2017(HY5), 2018(HY5), 2019(HY5), 2020(HY5), 2021(HY5), 2022 (HY5), 2023(PL2), 2024(PL2), 2025(PL2), 2026(PP1), 2027(PP1), 2028(PP1), 2029(PP1), 2030(SA3), 2031(SA3), 2032(SA3), 2033(SA3), 2034(ST5), 2035(ST5), 2036(ST5), 2037(ST5), 2038(PL2), 2039(PL2), 2040(AT2)[c], 2041(PL2)[c], 2042(PP1)[c], 2043(ST5)[c], 2044(SA3)[c], 2045(HY5)[c], 2046(PP1), 2047(PP1).

c. Discussion of several papers, grouped by divisions.

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